CLAIMS

What is claimed is:

1. An actuator, comprising:

(a) a substrate having a surface;

(b) an actuating device movable in a substantially linear direction with respect to the substrate;

(c) at least one bendable electrode beam attached to the actuating device and having an end attached to the substrate, the electrode beam being flexible between the actuating device and the end of the electrode beam attached to the substrate; and

(d) at least one electrode attached to the substrate, the electrode having a curved surface aligned in a position adjacent the length of the electrode beam, whereby the actuating device is movable in the substantially linear direction as the electrode beam moves in a curved fashion corresponding substantially to the curved surface of the electrode.

2. The actuator of claim 1 wherein the actuating device includes an optical component for interacting with light transmitted along a light pathway.

3. The actuator of claim 2 wherein the optical component is a shutter.

4. The actuator of claim 1 wherein the electrode beam is attached to the substrate via an anchor.

5. The actuator of claim 1 wherein the electrode beam includes a flexure portion attached between the actuating device and the end of the electrode beam attached to the substrate.

6. The actuator of claim 5 wherein the flexure portion is a two-fold flexure.

7. The actuator of claim 5 wherein the flexure portion is a one-fold flexure.

8. The actuator of claim 5 wherein the flexure portion is a crab leg flexure.

9. The actuator of claim 1 wherein the electrode beam is substantially straight and positioned substantially perpendicular to the linear direction.

10. The actuator of claim 1 wherein a first position along the length of the curved surface is closer to the electrode beam than a second position along the length of the curved surface that is closer to the actuating device.

11. The actuator of claim 1 wherein the maximum distance separating the curved surface and the electrode beam is between 35 and 50 micrometers.

12. The actuator of claim 1 wherein the at least one electrode beam includes a first and second electrode beam, the first electrode beam attached to actuating device on a first side, the second electrode beam attached to actuating device on a second side that opposes the first side for

translating motion of the curved electrode in the substantially linear direction.

13. The actuator of claim 1 further including at least one electrically-isolated bumper attached to the substrate at a position in the path of movement between the electrode beam and the electrode for preventing the electrode beam and the electrode from shunting.

14. An actuator, comprising:

(a) a substrate having a surface;

(b) an actuating device movable in a substantially linear first direction and a substantially linear second direction with respect to the substrate;

(c) at least one bendable electrode beam attached to the actuating device and having an end attached to the substrate, the electrode beam being flexible between the actuating device and the end of the electrode beam attached to the substrate;

(d) at least one first electrode attached to the substrate, the electrode having a curved surface aligned in a position adjacent the length of the electrode beam, whereby the actuating device is movable in its substantially linear first direction as the electrode beam moves in a curved fashion corresponding substantially to the curved surface of the first electrode; and

(e) at least one second electrode attached to the substrate, the electrode having a curved surface aligned in a position adjacent the length of the electrode beam, whereby the actuating device is movable in its

substantially linear second direction as the electrode beam moves in a curved fashion corresponding substantially to the curved surface of the first electrode.

15. The actuator of claim 14 wherein the actuating device includes an optical component for interacting with light transmitted along a light pathway substantially perpendicular to the first and second linear directions.

16. The actuator of claim 14 wherein the optical component is a shutter.

17. The actuator of claim 14 wherein the electrode beam includes a flexure portion.

18. The actuator of claim 17 wherein the flexure portion is a two-fold flexure.

19. The actuator of claim 17 wherein the electrode beam is substantially straight and positioned substantially perpendicular to the first and second direction.

20. The actuator of claim 17 wherein a first position along the length of the curved surface of the first electrode is closer to the electrode beam than a second position along the length of the curved surface of the first electrode that is closer to the actuating device.

21. The actuator of claim 14 wherein a first position along the length of the curved surface of the second electrode is closer to the electrode beam than a second position along the length of the curved surface of the second electrode that is closer to the actuating device.

22. The actuator of claim 14 wherein the at least one electrode beam includes at least two electrode beams.

23. An actuator, comprising:

(a) a substrate having a surface;

(b) an actuating device movable in a substantially linear direction with respect to the substrate;

(c) at least one bendable first electrode beam having an end attached to the substrate;

(d) at least one bendable second electrode beam attached to the first electrode beam and having an end attached to the actuating device, the electrode beam being flexible between the actuating device and the end of the electrode beam attached to the first electrode beam;

(e) at least one first electrode attached to the substrate, the electrode having a curved surface aligned in a position adjacent the length of the first electrode beam, whereby the actuating device is movable in its substantially linear direction as the first electrode beam moves in a curved fashion corresponding substantially to the curved surface of the first electrode;

(f) at least one second electrode attached to the substrate, the electrode having a curved surface aligned in a position adjacent the length of the second electrode beam, whereby the actuating device is movable in its substantially linear direction as the second electrode beam moves in a curved fashion corresponding substantially to the curved surface of the second electrode after the first electrode beam moves in a curved fashion corresponding substantially to the curved surface of the first electrode.

24. A method for moving an actuating device in a linear direction, comprising:

(a) providing a substrate having a surface;

(b) providing an actuating device movable in a substantially linear direction with respect to the substrate;

(c) providing at least one bendable electrode beam attached to the actuating device and having an end attached to the substrate, the electrode beam being flexible between the actuating device and the end of the electrode beam attached to the substrate;

(d) providing at least one electrode attached to the substrate, the electrode having a curved surface aligned in a position adjacent the length of the electrode beam; and

(e) applying a voltage across the electrode beam and curved electrode to move the electrode beam in a curved fashion corresponding to the curved surface of the electrode, whereby the actuating device moves in a substantially linear direction.

25. The method of claim 24 wherein the electrode beam includes a flexure portion attached between the actuating device and the end of the electrode beam attached to the substrate.